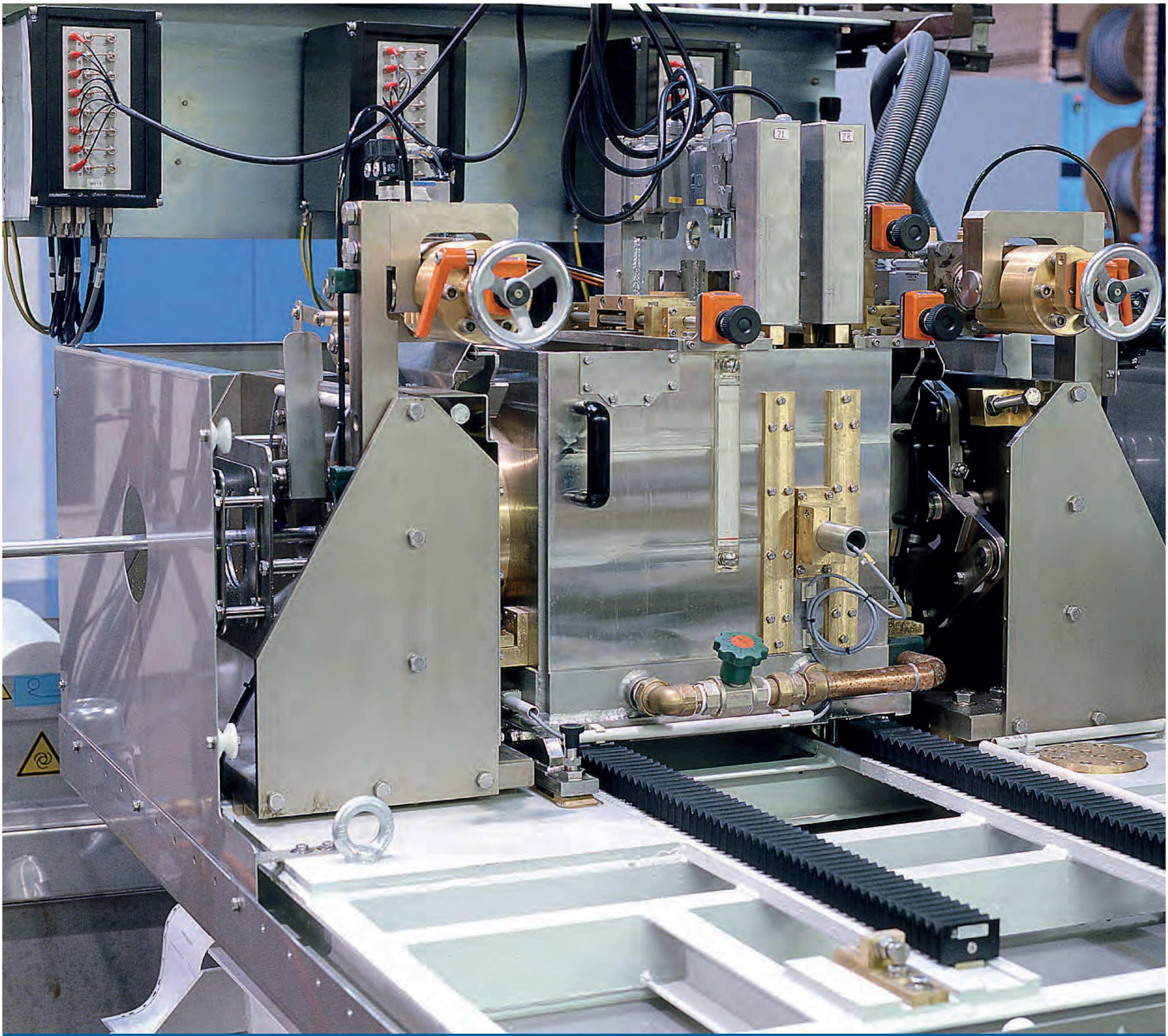
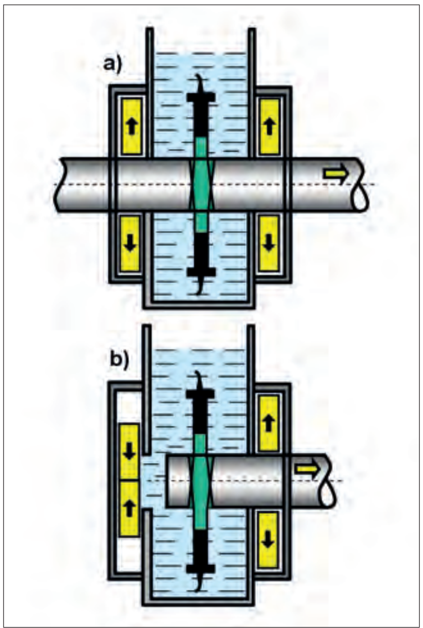


ECHOGRAPH-HRPS

High-Speed Ultrasonic Inspection of Bars

KARL DEUTSCH

ECHOGRAPH-HRPS
High-Speed Ultrasonic Inspection of Bars



Principle of closing mechanics of test chamber: a) opened test chamber while bar is tested, b) bar is leaving the test chamber and one side of chamber is already closed. The ultrasonic probes are active as long as the bar is within the ultrasonic beams. The electronic test enable signals (to activate the probes) are programmable to reach the shortest possible untested ends.

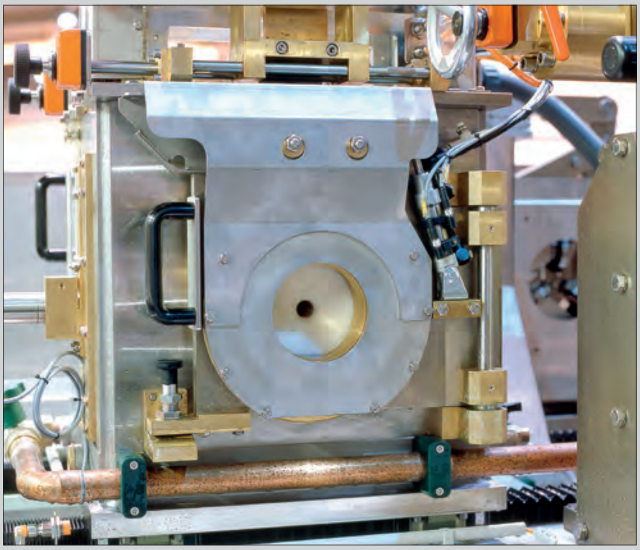
High-Speed Ultrasonic Inspection of Bars

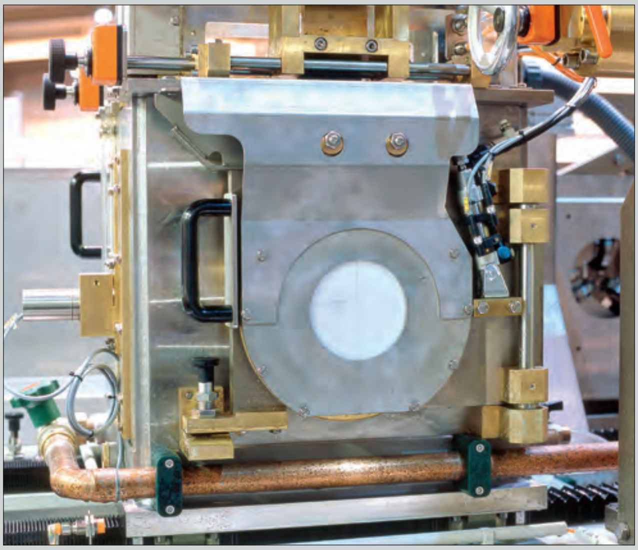
KARL DEUTSCH has developed ultrasonic testing equipment since 1951 and shipped the first inspection system for billet inspection in 1965. Many improvements for the ECHOGRAPH-electronics, the robust testing mechanics and the ultrasonic probes have led to our current state-of-the-art. KARL DEUTSCH maintains a strict quality management system according to DIN EN ISO 9001.

At the moment, a bar diameter range from 7 mm to 93 mm can be tested with the ECHOGRAPH-HRPS system. The testing system works with the immersion technique, meaning that the part of the bar to be inspected is fully immersed in water. The system uses a water chamber and several probe cassettes on which the ultrasonic probes are mounted around the circumference of the bar. No mechanical rotation is employed in this concept, therefore avoiding mechanical wear of the testing mechanics and the untested zones which might occur with helical test traces and high testing speeds.

A key feature of the testing concept with stationary probes is the high inspection speed of up to 2 m/s and the robust mechanics which shows very little wear since no rotational components are used. The ultrasonic pulse density in the transportation direction is high enough so that overlap in the transportation direction is produced. Therefore, another important feature of the system is the detection of short defects.

Most defects show a longitudinal geometry due to the rolling process. The determination of length for longitudinal defects is an easy task with stationary probes. The defect is always found by the same probe. Counting the pulses above the calibrated amplitude threshold and knowing the pulse density quickly produces the defect length. To avoid pseudo indications, e.g. from surface scratches, a pulse counter can be set to a value which is suitable for the bar quality. A minimum number of ultrasonic pulses exceeding the preset threshold is required before the system alarm becomes active. Again this feature can be used to adjust the minimum flaw length which should be detected with the system.





Water-filled test chamber in opened and closed condition

ECHOGRAPH-HRPS
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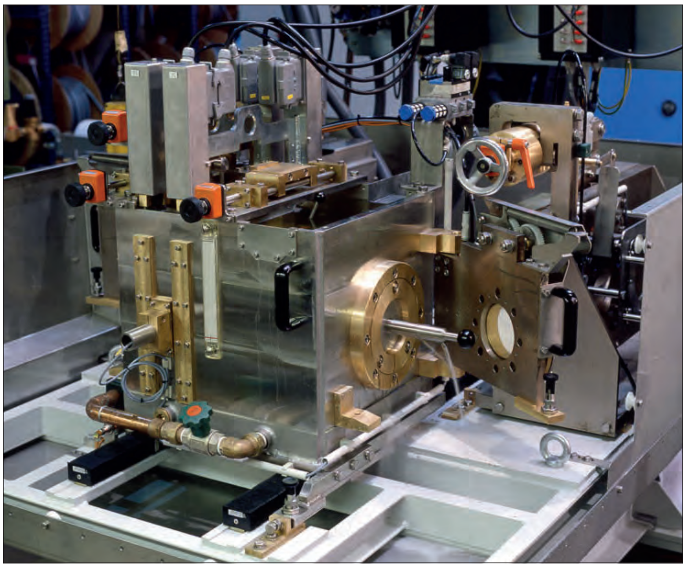
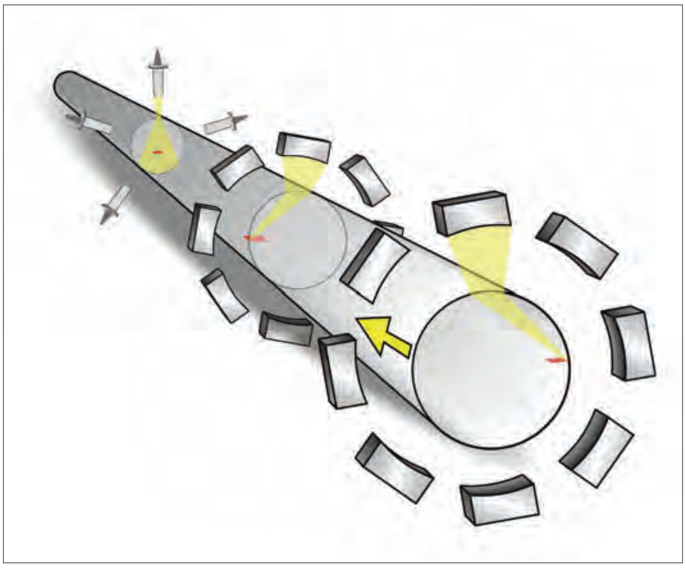
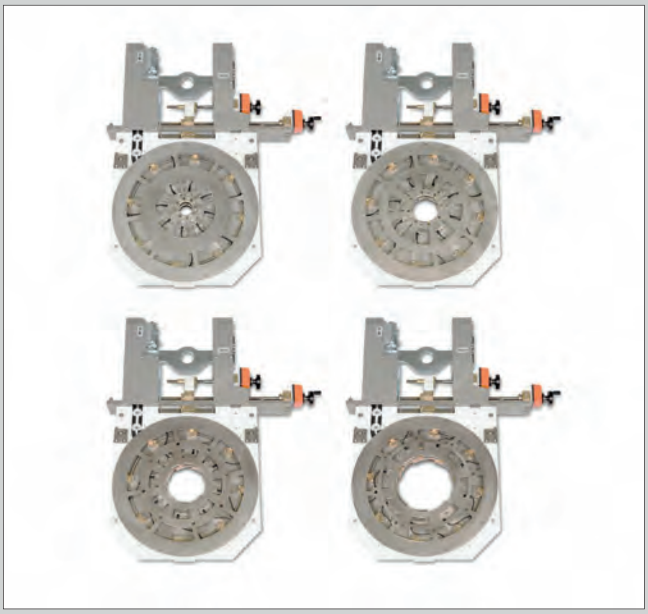


System calibration by means of short bar carrying artificial defects. The bar is rotated so the defect will pass each ultrasonic probe. Afterwards, the automated sensitivity adjustment equalizes the sensitivity of all probes. For the calibration process, the test chamber is moved into calibration position (offline).



Since invention of the HRPS-setup, many probe configurations have been realized. For bar testing, a setup with 16 angle beam probes and 5 straight beam probes has been proven to be a reliable setup for 100% cross sectional coverage of the bars. The more probes are used, the higher is the probability of detection (POD) also of oblique and crack-type defects.

Special line-focussed probes for angular incidence in different sizes to test the respective bar diameters: Each probe covers 30 degrees of the bar surface – independently from the bar diameter.



Test cassette with ring of ultrasonic probes: Angle beam probes are used to detect surface defects while straight beam probes are used to detect core defects.The testing angle of all angle beam probes is centrally adjusted by the spindle and the orange dial.

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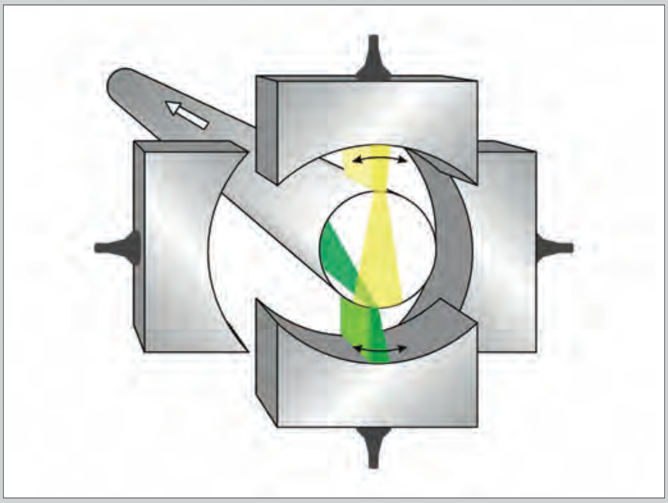

Similar test results can be obtained by using ultrasonic phased arrays. The bar is entirely enclosed by an annular ring array. The phased array technique can then be used to produce straight beam testing (yellow beam) or angle beam testing (green beam). The advantage of a phased array setup is the fast change-over time to different specimen dimensions and the possibility to adjust all test parameters electronically. On the other hand, this technique requires many electronic testing channels and extensive probe arrays.

Specimens	
Bars	
Diameter range (D)	10 mm - 90 mm
Specimen ends	machined, no burr
Straightness deviation	max. 1 mm/m
Surface condition	machined (desirable)
Ovality	max. 1% of D

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